

Consumer Grade KGDs from Philips for Telecom Applications



GOOD-DIE CONFERENCE
7th French Microelectronics Forum
Sofitel St Jacques, Paris

Wednesday, 3 April 1996

Arun Sam Amirtham
Philips Semiconductors, Zurich Switzerland

Motivation

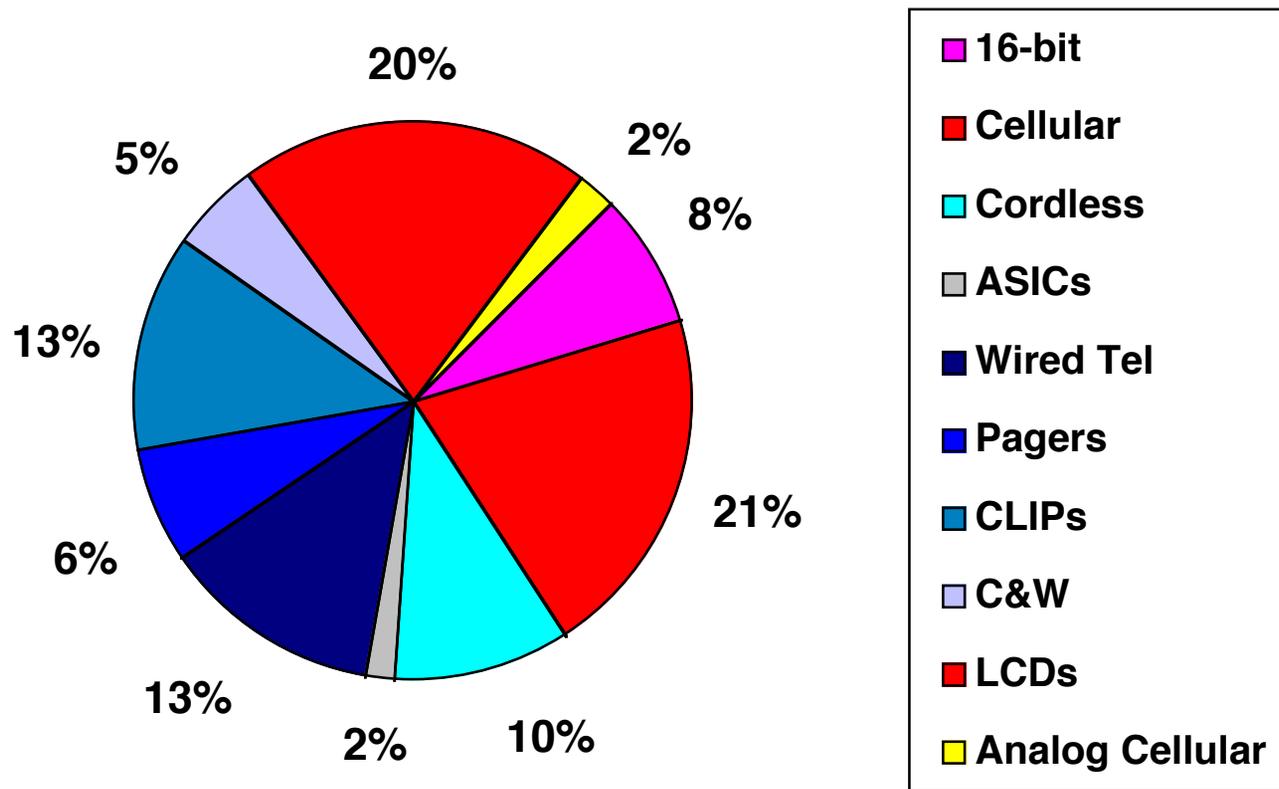
- FORECASTED GROWTH IN KGD/MCM MARKET WORLDWIDE
 - Total IC volume growth of 140% in a decade (106 billion in 2005)
 - High reliability KGD vol. growth of 2800% (320 million in 2005)
 - Consumer grade KGD vol. growth of 300% (6.5 billion in 2005)
 - Consumer grade KGDs will command 6% of the total market as opposed to 0.3% for high-rel KGDs
- IMPORTANCE OF CONSUMER GRADE KGD DELIVERIES WITHIN PHILIPS SEMICONDUCTORS AT ZURICH
 - Total delivery of 51 million units in 1996 covering 37 basic types
 - Covers low-voltage micros, telephony and pagers, peripherals, clocks and watches, LCD drivers and analogue cellular devices
 - Can also deliver 16-bit micros, cellular and cordless telecom ICs

Consumer Grade KGDs



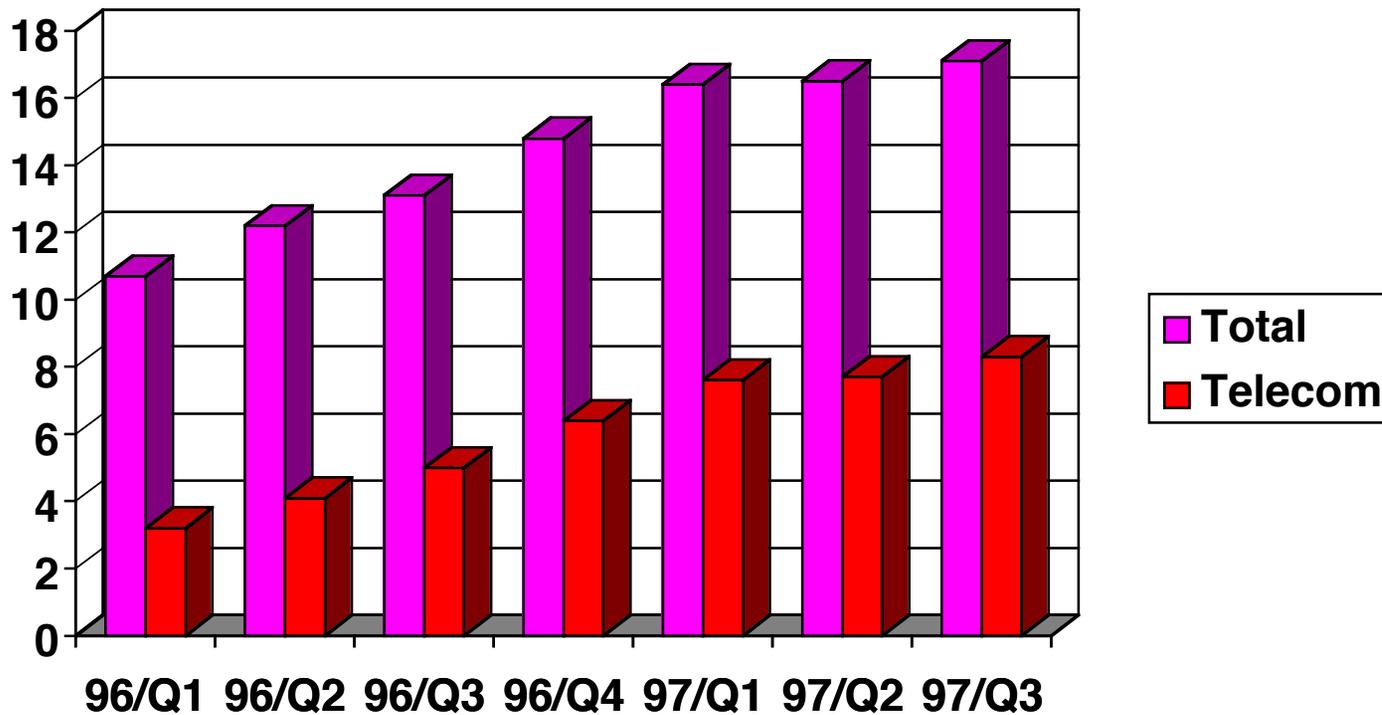
- Why consumer grade?
 - That is where our business lies
 - That is where the volume is interesting
 - Cost constraints must be given high priority when volumes are high
- What is consumer grade?
 - KGDs which can used in high-volume consumer applications (telecom end-terminals, hand-held portable devices, etc.)
 - Same reliability figures as packaged counterparts
 - Flip-chip, C&W, COG technologies are supported
 - MCM or assembly yield of well over 95%

Philips Semiconductors Zurich Product Portfolio



1996 Forecasted Sales

Consumer Grade KGD Deliveries



Volume in Million Units



Module Activities in Zurich



- BBM for AMPS/ETACS [OM 5300]
(P83CL580 + UMA1000L + SA5752/53 + TDA7050 + EEPROM)
- 1-Chip Basic Phone (TEA1062 + PCD3349A)
- 1-Chip Basic Phone/ Low-cost iteration (TEA1112 + PCD3349L)
- 1-Chip Mid-End Phone (LI + Dialer/Ringer + EEPROM)
- 1-Chip Feature Phone (LI + Handsfree + P83CLTELX)
- DECT ABC PCF5097 (Die-on-Die)
- GSM (PCF5083 + P90CL301)

Known Good Die



"A Known Good Die (KGD) is a die characterised by the same quality level as a packaged die."

- John Hage, Rockwell International

- Physical Specification
- Electrical Specification
- **Test Coverage and Test Specification**
- Quality Specification
- **Packing Specification**
- **Documentation**
- Design Data Availability

KGD Imperative: Test Flow



- Final-Tested Products
 - Tested at least at two different temperatures
 - Electrical batch release procedure for non-volatile memory
 - Electrical and Visual out-going inspection
- Die Deliveries
 - Tested at one temperature but characterised over temperature range
 - EEPROM retention / endurance can be verified if necessary
 - Electrical sampling prior to sawing plus visual out-going inspection
- Future Strategies
 - Multiple-pass wafer test flows
 - Retention bake / Endurance tests using chip-carrier technology
 - Electrical batch release and 100% automatic visual inspection

KGD Imperative: Test Content



- Pre-test is a full pre-test
 - All functions are verified, all parameters are covered
 - Guard-banding ensures a more stringent test than final test
 - Fast-mode is not applied / logistical flow differentiation
- Pre-test is at hot
 - Many parameters are critical at hot for CMOS devices
 - » Leakage currents
 - » Port driver currents
 - » IDD / ISS
 - » Device frequency / AC parameters
 - Test limits are correlated to lower temperatures

KGD Imperative: Test Coverage



- Testability and Test Coverage are Design Specifications
 - Verified and documented fault coverage (ETS)
 - Use of appropriate test strategies (Scan, BIST, Test ROMs, Margin Test Modes, Macro Test, IEEE 1149.1)
 - Successful approach for all new developments
- Test Coverage Improvement Activities
 - 8048-core fault coverage improvement in Zurich
 - 8051-core related work in other centres within Philips
 - 68000-derivate fault simulation and subsequent redesign
 - BIST in GSM processor and DECT chip set
 - IDDq test mode in all new LCD drivers

KGD Imperative: Design for Test



■ Applied Test Features

- BIST (GSM KISS DSPs)
- Test ROMs (P83CLXXX series microcontrollers)
- Scan Design (All original designs)
- Ad-hoc methods (As appropriate)
- Boundary Scan (PCF5081/82/83/84/85, PCF5076)
- IDDq (PCF2116, PCF2114, PCF2113, PCF2104....)

■ Future Strategies

- Features for MCM and system-level test / BSDL files
- Release of some test information or design simulation models
- Customer specific design-in support

KGD Imperative: Test Quality

■ Pre-test Features

- Hot pre-test provides an "intrinsic" burn-in
- Stress test is applied to provoke weak gate-oxide breakdowns
- More stringent "max-rating" current tests
- Stringent guard-banding at pre-test
- Multi-pass tests planned where appropriate
- Test Data Feedback in place for SPC and parameter monitoring
- KGD yield prediction based on PCM data and or final-test yield

KGD Imperative: Test Dialogue

- Dialogue within Philips
 - KGD Suppliers / MCM Manufacturers
 - IC Test Community / MCM and Board Test Community
 - Activities within Philips in USA / Asia-Pacific
 - KREPHELD Team
- Dialogue with equipment suppliers / tool developers
 - CAT tools
 - Test Equipment
 - Handling infrastructure
- Dialogue with the RoW
 - European Projects: GOOD-DIE, LOCOP
 - US Projects: ARPA, MCC

KGD Imperative: Delivery Format

■ Preferred Formats

- Unsawn Wafer
- Chip on FFC (Film Frame Carrier)
- Bumped Chip on FFC

■ Other Currently Available Formats

- Chip in Tray
- Bumped Chip in Tray
- Bumped Chip on Tape
- Unsawn Bumped Wafer
- Chip in Tray (250um thick)

KGD Imperative: Documentation

- Current Status
 - Device Data Sheet
 - Product Qualification Package
 - Electrical Test Specification (ETS)
- On-Going Activity
 - General Delivery Specification for KGDs
 - BSDL Files
 - VHDL models
 - GOOD-DIE Database

KGD Imperative: Plan the Future



- Test Procedures
 - Multi-pass pre-test
 - Evaluation of Chip-Carrier Technology
 - Introduction of SOTF quality sampling
 - JEDEC JC-14.3 (Outlier Identification and Management System - OIMS)
 - Investigation of yield levels based on assembled products (KGD yield monitoring)
- Documentation
 - General Delivery Specification for KGDs
 - PQPs for all products requested as KGDs
 - Design Simulation models and BSDL availability
 - Penetration into industry-wide databases such as the GOOD-DIE selection/design database

Philips Semiconductors Zurich

■ World Leaders in Telecom ICs and in Consumer Grade KGDs

■ Cellular

■ Cordless

■ Pagers

■ Wired Telecom

■ LCD Drivers

